§ 32. Optimization of Wall Geometry for CHS-qa Divertor Configuration

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The magnetic configuration of CHS-qa is produced by a modular coil system. In order to realize a divertor configuration, the modular coil is modified. By the modification of coil, the rotational transform outside of outermost magnetic surface is adjusted so that an island structure should appear in peripheral region. The island structure that corresponds to 2/5 rational mode number is utilized for CHS-qa. Fig.1 shows poloidal cross sections of the divertor configuration, of which toroidal angle is 0 and 90 degrees. The X points and divertor legs are produced outside of outermost magnetic surface. By this modification of modular coil the shape of outermost magnetic surface does not change, therefore the character of magnetic configuration can be maintained.

A vacuum vessel is initially located at a position 25 cm away from outermost magnetic surface, and the distance between outermost magnetic surface and the wall of vacuum vessel is selected anywhere same. The position of this first version of wall is shown with a dotted line in Fig.1. This wall has a problem that divertor foot points are localized on a limited area of wall. In Fig.2, divertor foot points on this wall are shown. Since the toroidal periodic number is 2 for CHS-qa, only half-toroidal section is shown. Most points are in the area of outboard side of horizontally elongated cross section. The localization of foot points leads to the concentration of thermal flux to wall, which causes some problems, such as erosion, sputtering, and impurity influx. To avoid the localization of foot points of divertor, the shape of vacuum vessel is optimized. The shape of vacuum vessel is parameterized with coefficients of fourier series, which are adjusted manually so that foot points should be distributed uniformly in toroidal direction. The optimized wall is drawn in Fig.1 by a solid line. At the vertically elongated cross section the bean shape of vacuum vessel is shrunk vertically, and at the horizontally elongated cross section the outboard side of wall is expanded to outward direction. Foot points on the wall of optimized vacuum vessel are shown in Fig.3. Compared with Fig.2, foot points are distributed uniformly in toroidal direction, and we can avoid the localization of them. The connection length of magnetic field is larger than 50 m. As an experimental system, this is sufficient to avoid some unfavorable effects from wall.

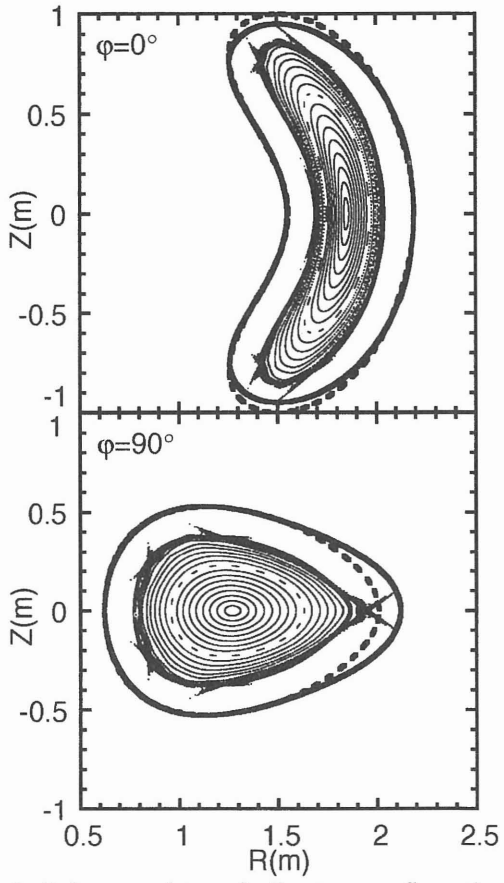

Fig.1 Poincare plots of divertor configurations. Top is for toroidal angle of 0°, bottom for 90°.

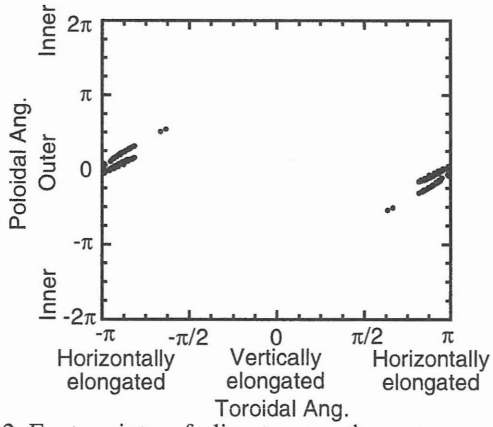

Fig.2 Foot points of divertor on the vacuum vessel. Wall is located at the position same distance anywhere away from the outer most magnetic surfae

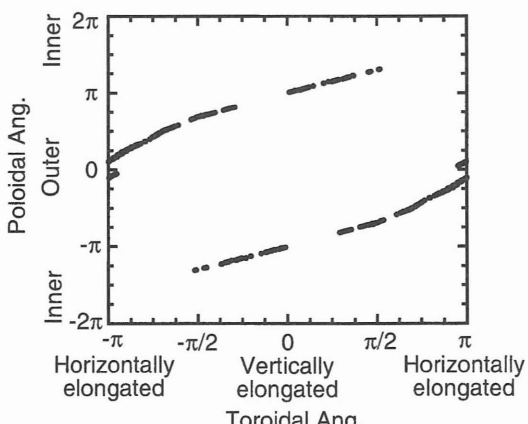

Fig.3 Same as Fig.2, but shape of wall is optimized. The localization of foot points is avoided.